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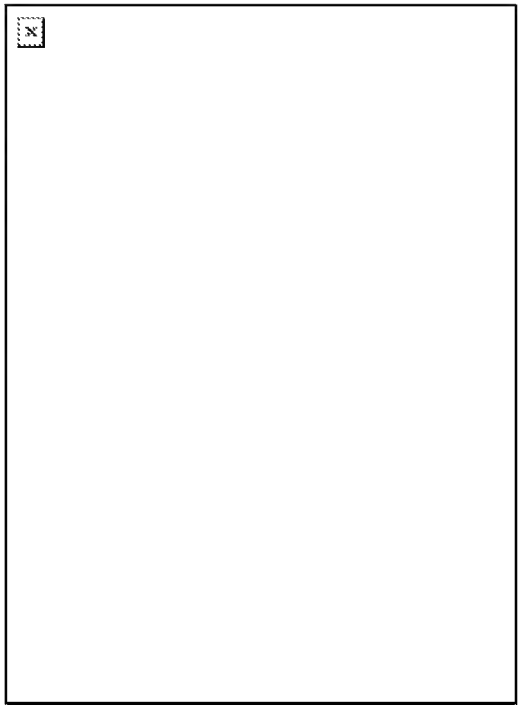
(71)Applicant : **MURATA MFG CO LTD**

(72)Inventor : **TAKESHIMA TETSUO**
SUMIDA MANABU
TAJIMA KIYOTAKA
SAKAI YUICHI

(54) **PIEZOELECTRIC ELECTROACOUSTIC TRANSDUCER AND ITS MANUFACTURING METHOD**

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a piezoelectric electroacoustic transducer with a stable frequency characteristics by applying an adhesive properly to fix a thin diaphragm to a case and of a conductive adhesive for electric connection between the diaphragm and the case so as to prevent distortion from occurring in the diaphragm.
SOLUTION: The piezoelectric electroacoustic transducer employs a 1st adhesive 13 that is applied to the shortest path tying a piezoelectric diaphragm 1 and interconnections 11a, 12a to fix the piezoelectric diaphragm to the case between the internal connections 11a, 12a of the outer circumferential part and the terminal of the rectangular piezoelectric diaphragm 1 in tortuous vibration in a broadwise direction by applying an alternate signal between electrodes, a conductive adhesive 14 that is applied between the electrodes and the internal connections of the terminal of the piezoelectric diaphragm via an upper face of the 1st adhesive 13 while bypassing the shortest path tying the piezoelectric diaphragm and the internal connections so as to electrically connect the electrodes and the internal connections of the terminal of the piezoelectric diaphragm, and a 2nd adhesive 15 that seals a gap between the outer circumferential part of the piezoelectric diaphragm and the inner circumferential part of the case.



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* NOTICES *

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CLAIMS

[Claim(s)]

[Claim 1] The piezo-electric diaphragm of the square which carries out a crookedness oscillation in the direction of board thickness by impressing an alternation signal to inter-electrode, The insulating case of the square which has

the supporter which supports a piezo-electric diaphragm inside the side-attachment-wall section, The terminal electrode which the internal connection section exposed near [supporter] the above, and this internal connection section and the external connection through which it flows exposed to the outside surface of a case, It is applied to the shortest path which is between the periphery section of a piezo-electric diaphragm, and the internal connection section, and connects a piezo-electric diaphragm and the internal connection section, and a piezo-electric diaphragm between the 1st adhesives fixed to a case, and the internal connection section of the electrode of a piezo-electric diaphragm, and a terminal electrode The electroconductive glue which bypasses the shortest path which connects a piezo-electric diaphragm and the internal connection section, is applied through the top face of the 1st adhesives, and connects electrically the internal connection section of the electrode of a piezo-electric diaphragm, and a terminal electrode, It is the piezo-electric mold electroacoustic transducer characterized by having the 2nd adhesives which close the clearance between the periphery section of a piezo-electric diaphragm, and the inner circumference section of a case, and the 1st and 2nd adhesives of the above having the Young's modulus smaller than electroconductive glue in a hardening condition.

[Claim 2] The 1st adhesives of the above are piezo-electric mold electroacoustic transducers according to claim 1 characterized by having the property in which the viscosity in the condition of not hardening is high and cannot permeate easily, compared with the 2nd adhesives.

[Claim 3] The 1st adhesives of the above are piezo-electric mold electroacoustic transducers according to claim 1 or 2 characterized by being selectively applied near [four] the corner of a piezo-electric diaphragm.

[Claim 4] The above-mentioned electroconductive glue is a piezo-electric mold electroacoustic transducer according to claim 3 characterized by being applied to at least two of the places near [four] the corner of a piezo-electric diaphragm.

[Claim 5] The process which prepares the piezo-electric diaphragm of the square

which carries out a crookedness oscillation in the direction of board thickness by impressing an alternation signal to inter-electrode, The process for which the insulating case of the square which has the supporter which supports a piezo-electric diaphragm inside the side-attachment-wall section, and has the terminal electrode which the internal connection section exposed near [supporter] the above, and this internal connection section and the external connection through which it flows exposed outside is prepared, The process which the shortest path which is between the periphery section of a piezo-electric diaphragm and the internal connection section, and connects a piezo-electric diaphragm and the internal connection section is made to apply and harden the 1st adhesives, and fixes a piezo-electric diaphragm to a case, The top face of the 1st adhesives is minded between the internal connection sections of the electrode of a piezo-electric diaphragm, and a terminal electrode. And the process which bypasses the shortest path which connects a piezo-electric diaphragm and the internal connection section, is made to apply and harden electroconductive glue, and connects electrically the internal connection section of the electrode of a piezo-electric diaphragm, and a terminal electrode, It is the manufacture approach of the piezo-electric mold electroacoustic transducer characterized by making the clearance between the periphery section of a piezo-electric diaphragm, and the inner circumference section of a case apply and harden the 2nd adhesives, having the process which closes between both, and the 1st and 2nd adhesives of the above having the Young's modulus smaller than electroconductive glue in a hardening condition.

[Claim 6] The 1st adhesives of the above are the manufacture approaches of the piezo-electric mold electroacoustic transducer according to claim 5 characterized by having the property in which the viscosity in the condition of not hardening is high and cannot permeate easily, compared with the 2nd adhesives.

[Claim 7] The 1st adhesives of the above are the manufacture approaches of the piezo-electric mold electroacoustic transducer according to claim 5 or 6 characterized by being selectively applied near [four] the corner of a piezo-

electric diaphragm.

[Claim 8] The above-mentioned electroconductive glue is a piezo-electric mold electroacoustic transducer according to claim 7 characterized by being applied to at least two of the places near [four] the corner of a piezo-electric diaphragm.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to a piezo-electric mold electroacoustic transducer and its manufacture approaches, such as a piezo-electric buzzer and a piezo-electric earphone.

[0002]

[Description of the Prior Art] Conventionally, in electronic equipment, home electronics, a portable telephone, etc., the piezo-electric mold electroacoustic transducer is widely used as the piezo-electric buzzer which generates an alarm tone and a sound of operation, or a piezo-electric earphone. Its thing of the structure which closed opening of a case with covering is common while this kind of piezo-electric mold electroacoustic transducer sticks a circular piezoelectric

device on one side of a circular metal plate, constitutes a uni-morph mold diaphragm, and silicone rubber is used for it and it supports the periphery section of a metal plate in a circular case. However, when the circular diaphragm was used, there was a trouble that productive efficiency was bad and it was difficult for sound conversion efficiency to constitute low and small.

[0003] Then, the piezo-electric mold electroacoustic transducer which enabled improvement in productive efficiency, the improvement in sound conversion efficiency, and a miniaturization is proposed by using a square diaphragm (JP,2000-310990,A). This piezo-electric mold electroacoustic transducer has a square piezo-electric diaphragm, and the bottom wall section and the four side-attachment-wall sections. The insulating case where had the supporter which supports a diaphragm inside the two side-attachment-wall sections which counter, and the 1st and the 2nd current carrying part for external connection were prepared in the supporter, While two sides and supporter with which it has the cover plate which has a sound emission hole, a diaphragm is contained in a case, and a diaphragm counters are fixed with adhesives or an elastic sealing agent The clearance between remaining two sides and cases of a diaphragm is closed with an elastic sealing agent, a diaphragm and the 1st and 2nd current carrying part are electrically connected by electroconductive glue, and it has structure which the cover plate pasted up on the side-attachment-wall section opening edge of a case.

[0004]

[Problem(s) to be Solved by the Invention] the diaphragm used for a piezo-electric mold electroacoustic transducer in recent years -- dramatically -- thin -- becoming -- about dozens-100 micrometers -- thin -- the **** diaphragm is used. such -- thin -- when a **** diaphragm is used, the effect which the supporting structure has on frequency characteristics becomes large. For example, when direct continuation of between a diaphragm and external electrodes is carried out with the electroconductive glue of heat-curing molds, such as an urethane system, distortion occurs in a diaphragm by the hardening contraction stress of

electroconductive glue, and frequency characteristics vary. Moreover, when surrounding temperature changes, when a property changes with the coefficient-of-thermal-expansion differences of a case and a diaphragm or external force joins a case, the direct force is transmitted also to a diaphragm, and a property may change.

[0005] When electroconductive glue is applied to the shortest path which connects between the supporters of the two sides and the case where a diaphragm counters, i.e., the internal connection section through which it flows in an external electrode, even if it applies electroconductive glue on it after fixing a diaphragm and a case by elastic support material as mentioned above, the stress generated by hardening contraction of electroconductive glue may act on a diaphragm, and problems, like frequency characteristics vary may occur.

[0006] Then, the object of this invention is devising the spreading location of the electroconductive glue which performs the adhesives and electrical installation which fix a diaphragm to a case, prevents distortion of a diaphragm and is to offer the piezo-electric mold electroacoustic transducer whose frequency characteristics were stable, and its manufacture approach.

[0007]

[Means for Solving the Problem] In order to attain the above-mentioned object, invention concerning claim 1 The piezo-electric diaphragm of the square which carries out a crookedness oscillation in the direction of board thickness by impressing an alternation signal to inter-electrode, The insulating case of the square which has the supporter which supports a piezo-electric diaphragm inside the side-attachment-wall section, The terminal electrode which the internal connection section exposed near [supporter] the above, and this internal connection section and the external connection through which it flows exposed to the outside surface of a case, It is applied to the shortest path which is between the periphery section of a piezo-electric diaphragm, and the internal connection section, and connects a piezo-electric diaphragm and the internal connection section, and a piezo-electric diaphragm between the 1st adhesives fixed to a

case, and the internal connection section of the electrode of a piezo-electric diaphragm, and a terminal electrode The electroconductive glue which bypasses the shortest path which connects a piezo-electric diaphragm and the internal connection section, is applied through the top face of the 1st adhesives, and connects electrically the internal connection section of the electrode of a piezo-electric diaphragm, and a terminal electrode, Having the 2nd adhesives which close the clearance between the periphery section of a piezo-electric diaphragm, and the inner circumference section of a case, the 1st and 2nd adhesives of the above offer the piezo-electric mold electroacoustic transducer characterized by the Young's modulus in a hardening condition being smaller than electroconductive glue.

[0008] The process which prepares the piezo-electric diaphragm of the square which carries out a crookedness oscillation in the direction of board thickness when invention concerning claim 5 impresses an alternation signal to inter-electrode, The process for which the insulating case of the square which has the supporter which supports a piezo-electric diaphragm inside the side-attachment-wall section, and has the terminal electrode which the internal connection section exposed near [supporter] the above, and this internal connection section and the external connection through which it flows exposed outside is prepared, The process which the shortest path which is between the periphery section of a piezo-electric diaphragm and the internal connection section, and connects a piezo-electric diaphragm and the internal connection section is made to apply and harden the 1st adhesives, and fixes a piezo-electric diaphragm to a case, The top face of the 1st adhesives is minded between the internal connection sections of the electrode of a piezo-electric diaphragm, and a terminal electrode. And the process which bypasses the shortest path which connects a piezo-electric diaphragm and the internal connection section, is made to apply and harden electroconductive glue, and connects electrically the internal connection section of the electrode of a piezo-electric diaphragm, and a terminal electrode, The clearance between the periphery section of a piezo-electric diaphragm and

the inner circumference section of a case is made to apply and harden the 2nd adhesives, it has the process which closes between both, and the 1st and 2nd adhesives of the above offer the manufacture approach of the piezo-electric mold electroacoustic transducer characterized by the Young's modulus in a hardening condition being smaller than electroconductive glue.

[0009] In this invention, after fixing between the periphery section of a diaphragm, and the internal connection sections of a terminal electrode with the 1st adhesives, between the internal connection sections of the electrode of a piezo-electric diaphragm and a terminal electrode is electrically connected with electroconductive glue. At this time, the 1st adhesives are applied and hardened by the shortest path which is between the periphery section of a piezo-electric diaphragm, and the internal connection section, and connects a piezo-electric diaphragm and the internal connection section, and through the top face of the 1st adhesives, electroconductive glue bypasses the shortest path which connects a piezo-electric diaphragm and the internal connection section, and is applied and hardened. Since the 1st adhesives are smaller than electroconductive glue, it is eased by the 1st adhesives and the Young's modulus in a hardening condition does not carry out the direct action of the stress generated by hardening contraction of electroconductive glue to a piezo-electric diaphragm. Therefore, distortion of a piezo-electric diaphragm does not occur and frequency characteristics do not vary. Moreover, since the 1st adhesives mitigate stress also when external force joins the time of surrounding temperature changing, and a case, stress hardly affects a piezo-electric diaphragm, but it can prevent that frequency characteristics change.

[0010] After facing manufacturing the piezo-electric mold electroacoustic transducer of this invention and containing a piezo-electric diaphragm in a case, the 1st adhesives may be applied, and before containing a piezo-electric diaphragm in a case, the 1st adhesives may be applied the periphery section of a piezo-electric diaphragm, or near the supporter of a case. In the case of the former, the 1st adhesives are applied using a dispenser, but adhesion

immobilization of the case of the latter may be carried out by applying the 1st adhesives to the edge of a piezo-electric diaphragm not only using the approach of using a dispenser but using a trowel etc., and containing this piezo-electric diaphragm in a case.

[0011] Like claim 2, compared with the 2nd adhesives, the 1st adhesives have the high viscosity in the condition of not hardening, and what has the property which cannot permeate easily is desirable. That is, when the viscosity in the condition of not hardening has the 1st low adhesives, the 1st adhesives close the internal connection section of the electrode of a piezo-electric diaphragm, or a terminal electrode in being easy to permeate, and applying electroconductive glue, it may become difficult to make it flow with the internal connection section of the electrode of a piezo-electric diaphragm or a terminal electrode. Moreover, the 1st adhesives may not remain in the shortest path part which connects the periphery section and the internal connection section of a piezo-electric diaphragm. Then, by using the 1st adhesives of the property which cannot permeate easily, such a problem is solved, the shortest path can be certainly bypassed with electroconductive glue, and a piezo-electric diaphragm and a terminal electrode can be connected.

[0012] Like claim 3, it is good to apply the 1st adhesives selectively near [four] the corner of a piezo-electric diaphragm. As the 1st adhesives, when the adhesives of a heat hardening mold are used, as for the center section of four sides of a case, deformation becomes large, and, also in the stress to a piezo-electric diaphragm, stress acts on the center section of four sides greatly. On the other hand, if the 1st adhesives are selectively applied near [four] the corner of a piezo-electric diaphragm, since deformation of a case is small, there will be little effect on a piezo-electric diaphragm at the time of hardening of the 1st adhesives, and it will end at it.

[0013] Electroconductive glue may be applied to at least two of the places near [four] the corner of a piezo-electric diaphragm like claim 4. Although generating of a piezo-electric diaphragm of distortion can be controlled if the 1st adhesives

are selectively applied near [four] the corner of a piezo-electric diaphragm like claim 3, effect of distortion by the stress generated by hardening contraction of electroconductive glue can be further lessened still like claim 4 by applying electroconductive glue to at least two in the 1st adhesives.

[0014] With the manner of support, a diaphragm may carry out a crookedness oscillation in the case where a crookedness oscillation is carried out in die-length bending mode, and area crookedness mode. The former is the mode which carries out a crookedness oscillation in the direction of board thickness by using the die-length direction both ends as the supporting point. two diagonal line locations which the latter uses four sides or four points as the supporting point, and make the principal plane of a diaphragm -- max -- it becomes a variation rate -- as -- that is, the intersection of the diagonal line -- max -- a variation rate -- it is the mode in which the whole area of a diaphragm carries out a crookedness oscillation in the thickness direction so that it may become an amount.

[0015] In this invention, the conductive paste of an urethane system is desirable as electroconductive glue. What has the Young's modulus lower than an electroconductive glue agent in a hardening condition as the 1st adhesives is used, for example, urethane system adhesives can be used. As the 2nd adhesives, Young's modulus is still lower than the 1st adhesives, and the low thing of hardening contraction stress is also good, for example, silicone system adhesives can be used. In addition, although it is also possible to use the adhesives of a room-temperature-setting mold as the 1st and 2nd adhesives, since hardening is started in the middle of spreading in case it applies by a dispenser etc., it is easy to generate plugging in a dispenser, and workability is bad. On the other hand, if it is the adhesives of a heat-curing mold, since viscosity is fixed in ordinary temperature, viscosity does not change in the middle of spreading, and plugging does not occur in a dispenser, but there is an advantage that workability is good.

[0016]

[Embodiment of the Invention] Drawing 1 - drawing 5 show the piezo-electric

mold electroacoustic transducer of the surface mount mold which is the 1st operation gestalt of this invention. This electroacoustic transducer fits the application used with single frequency like a sounder or a ringer, and consists of the diaphragms 1, the cases 10, and cover plates 20 of a profile and a uni-morph mold.

[0017] As shown in drawing 5 , a diaphragm 1 has electrode 2a of a thin film or a thick film, and 2b at the table rear face, and the piezo-electric plate 2, the piezo-electric plate 2, and width method of four square shapes by which polarization was carried out in the thickness direction are the same, and are formed in a square with a little long linear dimension, and it consists of metal plates 3 by which pair face bonding was carried out to rear-face electrode 2b of the piezo-electric plate 2 through electroconductive glue etc. In addition, rear-face electrode 2b may be omitted and rear-face electrode 2b may be omitted by joining a metal plate 3 to the rear face of the piezo-electric plate 2 directly through electroconductive glue etc. In this example, the location where the piezo-electric plate 2 inclined toward the one-side side of the die-length direction to the metal plate 3 is pasted, and it has outcrop 3a which the metal plate 3 exposed in the other side side of the die-length direction of a metal plate 3.

[0018] As a piezo-electric plate 2, electrostrictive ceramics, such as PZT, is used, for example. Moreover, a metal plate 3 has a desirable ingredient with the as near Young's modulus of phosphor bronze, 42nickel, etc. with the desirable for example, ingredient which combines right conductivity and spring elasticity as the piezo-electric plate 2. Here, ceramics (PZT etc.) and a coefficient of thermal expansion used the metal plate made from 42nickel near and whose vertical x horizontal x thickness are 10mmx10mmx0.05mm as a metal plate 3. Moreover, the PZT plate whose vertical x horizontal x thickness is 8mmx10mmx0.05mm as a piezo-electric plate 2 was used.

[0019] The case 10 is formed in the core box of four square shapes which have bottom wall section 10a and the four side-attachment-wall sections 10b-10e with insulating ingredients, such as ceramics or resin. When it constitutes a case 10

from resin, heat-resistant resin, such as LCP (liquid crystal polymer), SPS (syndiotactic polystyrene), PPS (polyphenylene sulfide), and epoxy, is desirable. 10f of annular level difference sections was prepared in the inner circumference of the four side-attachment-wall sections 10b-10e, and the internal connection sections 11a and 12a of the terminals 11 and 12 of the couple which is a terminal electrode are exposed on 10f of level difference sections of the inside which are the two side-attachment-wall sections 10b and 10d which counter. Insert molding of the terminals 11 and 12 is carried out to a case 10, and the external connections 11b and 12b which projected in the exterior of a case 10 are bent to the base side of a case 10 along the outside surface which are the side-attachment-wall sections 10b and 10d. this example -- the internal connection sections 11a and 12a of terminals 11 and 12 -- two forks -- a ** -- separating -- **** -- these two forks -- it is located near the both ends whose internal connection sections 11a and 12a of a ** are 10f of level difference sections, and, moreover, the internal connection sections 11a and 12a are making the shape of an inverse triangle [breadth at last].

[0020] Inside 10f of level difference sections, as shown in drawing 3 , 10g of annular supporters for supporting the periphery of a diaphragm 1 is formed lower one step than 10f of level difference sections. Therefore, if a diaphragm 1 is laid on 10g of supporters, the top panel of a diaphragm 1 and the top face of the internal connection sections 11a and 12a of terminals 11 and 12 will become the same height mostly. In addition, 1st sound emission hole 10k is formed in bottom wall section 10a, and 10l. of notches used as the 2nd sound emission hole is formed in the rising wood of side-attachment-wall 10e (refer to drawing 1 and drawing 4).

[0021] The above-mentioned diaphragm 1 is contained in a case 10 so that a metal plate 3 may turn to bottom wall section 10a of a case 10, and four sides are laid on 10g of supporters of a case 10. And adhesion immobilization of near [four] the corner of a diaphragm 1 is carried out by the elastic support material (the 1st adhesives) 13. That is, adhesion immobilization of the shortest path

which connects outcrop 3a and internal connection section 11a between internal connection section 11a of a terminal 11 near the both ends of outcrop 3a of a metal plate 3 that is, is carried out by the elastic support material 13, and adhesion immobilization of between internal connection section 12a of a terminal 12 this and near the both ends of the side which counters is carried out by the elastic support material 13. In this example, the elastic support material 13 applied to the corner of one vertical angle of a diaphragm 1 is not restricted to this, although the elastic support material 13 which is an oblong ellipse form or an ellipse and is applied to the corner of the vertical angle of another side along the side side of a diaphragm 1 is a circular letter of a drop by drop titration. As elastic support material 13, the urethane system adhesives of 3.7x106 Pa are used, for example for the Young's modulus after hardening. Moreover, since it has the property which cannot permeate easily more highly (for example, 50 - 120 dPa-s) than the elastic sealing agent 15 which the viscosity in the condition of this elastic support material 13 of not hardening mentions later, when the elastic support material 13 is applied, the elastic support material 13 rises to Yamagata. Heat hardening is carried out after applying the elastic support material 13. In addition, as the fixed approach of a diaphragm 1, after containing a diaphragm 1 in a case 10, the elastic support material 13 may be applied by a dispenser etc., but where the elastic support material 13 is beforehand applied to a diaphragm 1, a diaphragm 1 may be held in a case 10.

[0022] The diaphragm 1 fixed to the case 10 by the elastic support material 13 and the internal connection sections 11a and 12a of terminals 11 and 12 are electrically connected with electroconductive glue 14. That is, it applies to an ellipse form so that the elastic support material 13 top to which electroconductive glue 14 was applied by the ellipse form or the ellipse at the corner of one vertical angle of a diaphragm 1 may be crossed. Since the elastic support material 13 is rising to Yamagata, electroconductive glue 14 bypasses the shortest path which connects a diaphragm 1 and the internal connection sections 11a and 12a, and is applied. Under the present circumstances, it is necessary to warn against

adhering to the part to which electroconductive glue 14 is a clearance between a diaphragm 1 and the internal connection sections 11a and 12a, and the elastic support material 13 is not applied. As electroconductive glue 14, the urethane system conductive paste of 0.3x109 Pa is used, for example for the Young's modulus after hardening. After applying electroconductive glue 14, heat hardening of this is carried out.

[0023] Between the perimeter perimeter of a diaphragm 1, and the inner circumference section of a case 10, it is closed with the elastic sealing agent (the 2nd adhesives) 15, and the air leak between the side front of a diaphragm 1 and a background is prevented. Heat hardening is carried out after applying the elastic sealing agent 15 annularly. In this example, the Young's modulus for example, after hardening is using the silicone system adhesives of 3.0x105 Pa as an elastic sealing agent 15.

[0024] After fixing a diaphragm 1 to a case 10 as mentioned above, a cover plate 20 pastes top-face opening of a case 10 with adhesives 21. A cover plate 20 is formed with the same ingredient as a case 10. By pasting up a cover plate 20, sound space is formed between a cover plate 20 and a diaphragm 1. The piezo-electric mold electroacoustic transducer of a surface mount mold is completed as mentioned above.

[0025] If a predetermined alternation signal (an AC signal or square wave signal) is impressed between the terminal 11 prepared in the above-mentioned case 10, and 12, since four sides of a diaphragm 1 are being fixed to 10g of supporters of a case 10, a diaphragm 1 can vibrate in area crookedness mode, and can generate a predetermined sound. The generated sound is emitted to the exterior from the sound emission hole formed between a cover plate 20 and 10l. of notches of a case 10.

[0026] Although the metal plate 3 of a diaphragm 1 was turned to the bottom wall section 10a side of a case 10 and it fixed in the above-mentioned explanation, the piezo-electric plate 2 may be turned to the bottom wall section 10a side of a case 10, and you may fix. Since surface electrode 2a of the piezo-electric plate 2

and outcrop 3a of a metal plate 3 are exposed to an upside when a metal plate 3 is turned to the bottom wall section 10a side and it fixes, connection between outcrop 3a and a terminal 11 and connection between surface electrode 2a and a terminal 12 can be easily made using electroconductive glue 14. In addition, since it has the role which prevents that the elastic support material 13 enters the clearance between a diaphragm 1 and a case 10 as mentioned above, and electroconductive glue 14 adheres to a metal plate 3 although it becomes a faulty connection when connecting surface electrode 2a and a terminal 12, and electroconductive glue 14 adheres to a metal plate 3, a faulty connection can be prevented certainly.

[0027] Drawing 6 - drawing 11 show the piezo-electric mold electroacoustic transducer which is the 2nd operation gestalt of this invention. The electroacoustic transducer of this operation gestalt is used for the application corresponding to the frequency of a large range like a piezo-electric earphone. This electroacoustic transducer consists of a profile, and the diaphragm 30, the case 10 and cover plate 20 of a laminated structure. Except for a case 10 and a diaphragm 30, other configurations are almost the same as that of the 1st operation gestalt shown in drawing 1 - drawing 5 , give the same sign to the same part, and omit duplication explanation.

[0028] The point that this case 10 differs from the case 10 in the 1st operation gestalt The point currently formed only in the inside which are two side attachment walls 10b and 10d with which 10g of supporters counters as shown in drawing 8 , As shown in drawing 9 , it is the inside of other two side-attachment-wall sections 10c and 10e, and they are the point that 10h of slots for elastic sealing agent flow stops is formed in the location lower than 10g of supporters, and the point that the sound emission hole 23 is formed in the cover plate 20.

[0029] As shown in drawing 10 and drawing 11 , as for a diaphragm 30, the laminating of the two-layer electrostrictive ceramics layers 31 and 32 is carried out, the principal plane electrodes 33 and 34 are formed in the front flesh-side principal plane of a diaphragm 30, and the internal electrode 35 is formed among

the ceramic layers 31 and 32. As a thick wire arrow head shows to drawing 11 , in the thickness direction, polarization of the two ceramic layers 31 and 32 is carried out in the same direction. The principal plane electrode 33 on a side front and the principal plane electrode 34 on a background are formed a little shorter than the side length of a diaphragm 30, and the end is connected to the end-face electrode 36 formed in one end face of a diaphragm 30. Therefore, the principal plane electrodes 33 and 34 of a front flesh side are connected mutually. The internal electrode 35 was mostly formed in the symmetry configuration with the principal plane electrodes 33 and 34, it is separated from the end of an internal electrode 35 of the internal electrode with the above-mentioned end-face electrode 36, and the other end is connected to the end-face electrode 37 formed in the other end side of a diaphragm 30. In addition, the end-face electrode 37 and the flowing auxiliary electrode 38 are formed in the table rear face of the other end of a diaphragm 30.

[0030] The wrap resin layer 39 is formed in the table rear face of a diaphragm 30 in the principal plane electrodes 33 and 34. Since the diaphragm 30 consists of only ceramic ingredients, this resin layer 39 is formed in order to raise shatter strength. And notch 39a which the principal plane electrodes 33 and 34 expose near the corner of the vertical angle of a diaphragm 30, and notch 39b which an auxiliary electrode 38 exposes are formed in the resin layer 39 of a front flesh side. In addition, although Notches 39a and 39b may be formed only in front flesh-side one side, in order to abolish the directivity of a front flesh side, in this example, it has prepared in the table rear face. Moreover, it is not necessary to use an auxiliary electrode 38 as the band electrode of constant width, and only the part corresponding to notch 39b may be established. Here, the 10mmx10mmx20micrometer PZT system ceramics was used as ceramic layers 31 and 32, and the polyamidoimide system resin whose thickness is 5-10 micrometers as a resin layer 39 was used.

[0031] The above-mentioned diaphragm 30 is contained by the case 10, and is fixed to 10g of supporters of a case 10 by the elastic support material 13 by four

places. The elastic support material 13 is applied to an oblong ellipse form between the principal plane electrodes 33 and internal connection section 11a of a terminal 11 which are exposed to notch 39a in a diagonal location, and between the auxiliary electrodes 38 and internal connection section 12a of a terminal 12 which are exposed to notch 39b. Moreover, the elastic support material 13 is applied to an oblong ellipse form also about the two remaining places. Heat hardening of the elastic support material 13 is carried out after spreading. In addition, as the fixed approach of a diaphragm 30, after containing a diaphragm 30 in a case 10, the elastic support material 13 may be applied by a dispenser etc., but where the elastic support material 13 is beforehand applied to a diaphragm 30, a diaphragm 30 may be held in a case 10.

[0032] After stiffening the elastic support material 13, it applies to an ellipse form so that the elastic support material 13 top to which electroconductive glue 14 was applied by the ellipse form may be crossed, and the principal plane electrode 33, internal connection section 11a of a terminal 11 and an auxiliary electrode 38, and internal connection section 12a of a terminal 12 are connected, respectively. That is, electroconductive glue 14 bypasses the shortest path which connects a diaphragm 30 and the internal connection sections 11a and 12a, and is applied. Heat hardening is carried out after applying electroconductive glue 14.

[0033] After applying and stiffening electroconductive glue 14, the elastic sealing agent 15 is applied to the clearance between a diaphragm 30 and the inner circumference section of a case 10, and between both is closed. Since the elastic sealing agent 15 is caught at 10h of slots formed inside the two side-attachment-wall sections 10c and 10e at this time as shown in drawing 9 R> 9, to bottom wall section 10a, the elastic sealing agent 15 flows and does not fall. Therefore, between a diaphragm 30 and cases 10 is closed certainly.

[0034] With the electroacoustic transducer of this operation gestalt, the crookedness oscillation of the diaphragm 30 can be carried out by impressing a predetermined alternation electrical potential difference between a terminal 11 and 12. Since the electrostrictive ceramics layer the direction of polarization and

whose direction of electric field are the same directions is shrunken in the direction of a flat surface and the electrostrictive ceramics layer the direction of polarization and whose direction of electric field are hard flow is extended in the direction of a flat surface, it is crooked in the thickness direction as a whole. In the case of this operation gestalt, a diaphragm 30 is the laminating structure of the ceramics which does not have a metal plate, and since two oscillating fields arranged in order in the thickness direction vibrate to hard flow mutually, compared with a uni-morph mold diaphragm, the big amount of displacement, i.e., big sound pressure, can be obtained.

[0035] With the 2nd operation gestalt, although the supporter was formed in the two-side overall length of a case, supporter 10i may be prepared in four corners like the case 10 shown in drawing 12 . In this case, four corners of a diaphragm 30 are fixed to supporter 10i by the elastic support material 13. Thus, by supporting only the corner of a diaphragm 30, resonance frequency can be lowered and the sound pressure of a low frequency region can be raised. In addition, in drawing 6 R> 6 and drawing 12 , 10f of level difference sections and 10h (refer to drawing 9) of slots of slight width prepared inside the side-attachment-wall sections 10c and 10e were omitted.

[0036] This invention is not limited to the above-mentioned operation gestalt, and can be changed in the range which does not deviate from the meaning of this invention. For example, although a diaphragm 30 carries out the laminating of the two-layer electrostrictive ceramics layer, what carried out the laminating of the three or more-layer electrostrictive ceramics layer may be used. Moreover, diaphragms 1 and 30 may be any of a square and a rectangle. Although the 1st operation gestalt explained the uni-morph mold diaphragm which stuck the piezo-electric plate on one side of a metal plate, the bimorph form diaphragm which stuck the piezo-electric plate on both sides of a metal plate may be used. Although it set up with the above-mentioned operation gestalt so that the diaphragm and the internal connection section which made the supporter of a case lower one step than the internal connection section of a terminal electrode,

and were supported by the supporter of a case might become the same height mostly, the supporter and the internal connection section of a case may be made into the same height, and a diaphragm may be fixed on it. The terminal electrode in this invention may be an electrode of the thin film from the supporter top face of a case to [does not restrict to an insertion terminal like the above-mentioned operation gestalt, and] outside for example, or a thick film. The same ingredient may be used although the ingredient which is hard to permeate from the 2nd adhesives as the 1st adhesives (elastic support material) was used with the above-mentioned operation gestalt. The spreading location of the 1st adhesives may cover the overall length of two sides which what [not only] was selectively applied near [four] the corner of a diaphragm but a diaphragm counters, and may be applied continuously. Moreover, as long as the spreading location of electroconductive glue is for pulling out the electrode of not only two places of the vertical angle of a diaphragm but a diaphragm outside, what kind of location is sufficient as it. The case of this invention is not restricted to what consisted of a case of a concave cross-section configuration like an operation gestalt, and a cover plate adhered to the top face.

[0037]

[Effect of the Invention] After fixing the between the periphery section of a diaphragm, and near the supporter of a case with the 1st adhesives by the above explanation according to invention according to claim 1 so that clearly, In case between the internal connection sections of the electrode of a piezo-electric diaphragm and a terminal electrode is electrically connected with electroconductive glue, electroconductive glue bypasses the shortest path which connects a piezo-electric diaphragm and the internal connection section through the top face of the 1st adhesives, and since it applies and hardens It is eased by the 1st adhesives and the direct action of the hardening contraction stress of electroconductive glue is not carried out to a piezo-electric diaphragm. therefore -- thin -- even if it is a **** piezo-electric diaphragm, distortion does not occur, and frequency characteristics do not vary Moreover, since the 1st adhesives mitigate

stress also when external force joins the time of surrounding temperature changing, and a case, stress hardly affects a piezo-electric diaphragm, but it has the operation effectiveness that it can prevent that frequency characteristics change.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the decomposition perspective view of the 1st operation gestalt of the piezo-electric mold electroacoustic transducer concerning this invention.

[Drawing 2] It is a top view in the condition of having excepted the cover plate and the 2nd adhesives of a piezo-electric mold electroacoustic transducer which are shown in drawing 1 .

[Drawing 3] It is a stairway sectional view by the A-A line of drawing 2 .

[Drawing 4] It is the B-B line sectional view of drawing 2 .

[Drawing 5] It is the perspective view of the piezo-electric diaphragm used for the piezo-electric mold electroacoustic transducer of drawing 1 .

[Drawing 6] It is the decomposition perspective view of the 2nd operation gestalt of the piezo-electric mold electroacoustic transducer concerning this invention.

[Drawing 7] It is a top view in the condition of having excepted the cover plate and the 2nd adhesives of a piezo-electric mold electroacoustic transducer which are shown in drawing 6 .

[Drawing 8] It is a stairway sectional view by the C-C line of drawing 7 .

[Drawing 9] It is D-D line sectional view of drawing 7 .

[Drawing 10] It is the perspective view of the piezo-electric diaphragm used for the piezo-electric mold electroacoustic transducer of drawing 6 .

[Drawing 11] It is a stairway sectional view by the E-E line of drawing 10 .

[Drawing 12] It is the perspective view of the modification of a case.

[Description of Notations]

1 30 Piezo-electric diaphragm

10 Case

10g Supporter

11 12 Terminal (terminal electrode)

11a, 12a Internal connection section

11b, 12b External connection

13 Elastic Support Material (1st Adhesives)

14 Electroconductive Glue

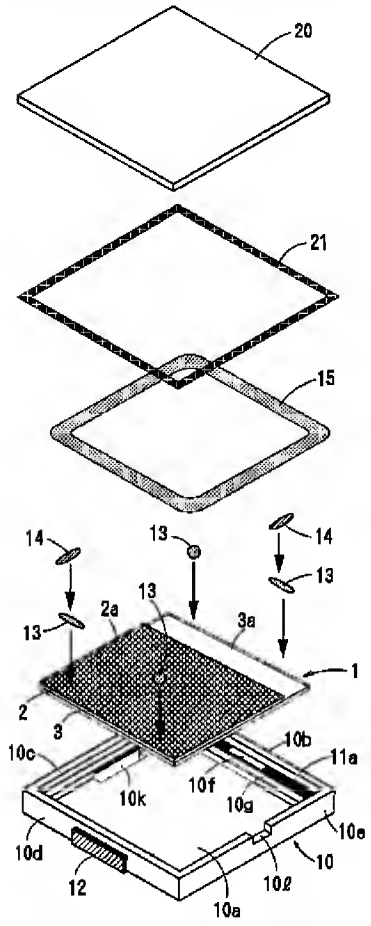
15 Elastic Sealing Agent (2nd Adhesives)

20 Cover Plate

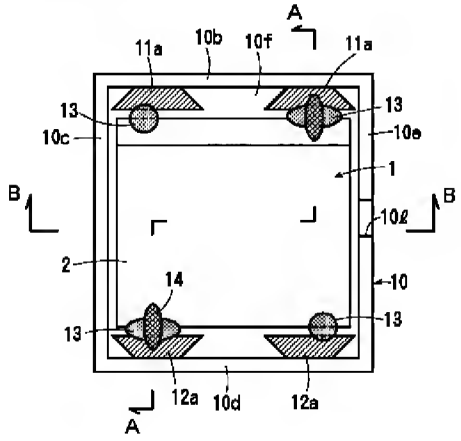
[Translation done.]

DRAWINGS

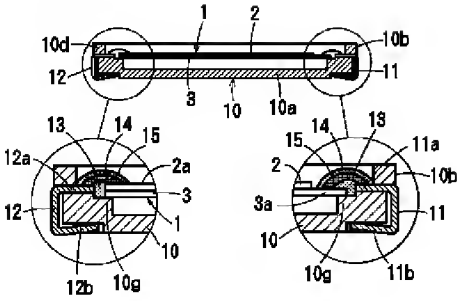
[Drawing 1]



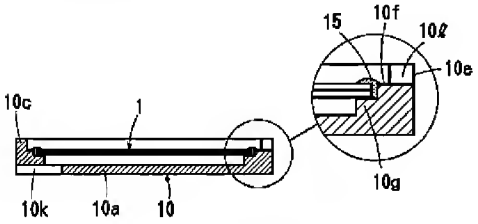
[Drawing 2]



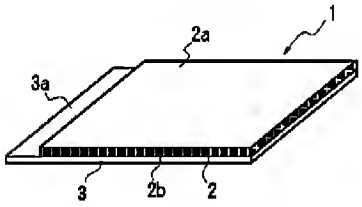
[Drawing 3]



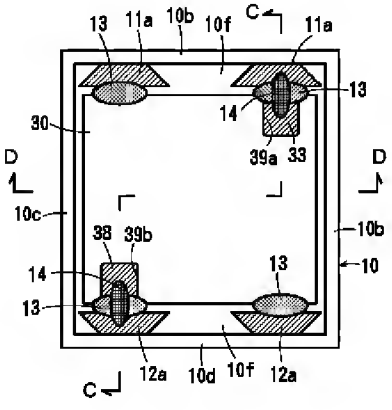
[Drawing 4]



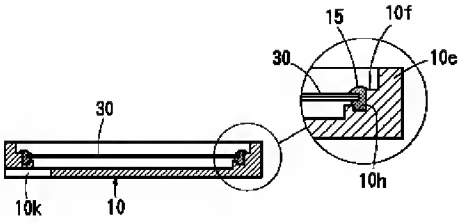
[Drawing 5]



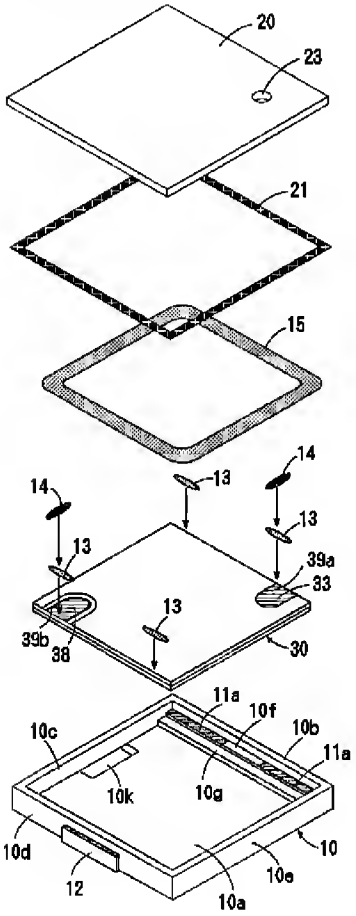
[Drawing 7]



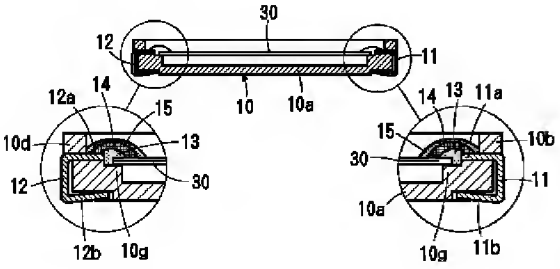
[Drawing 9]



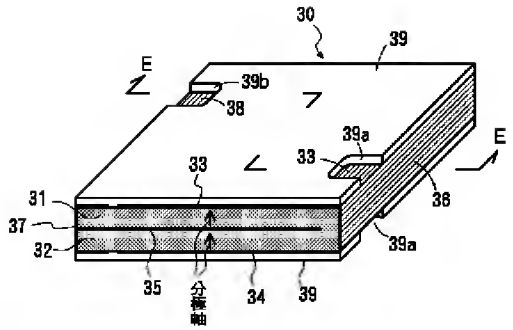
[Drawing 6]



[Drawing 8]



[Drawing 10]



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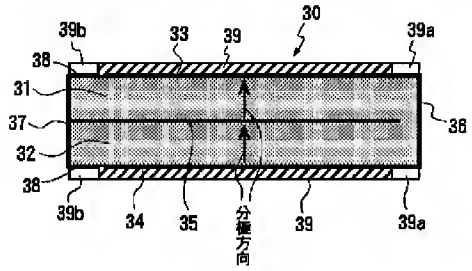
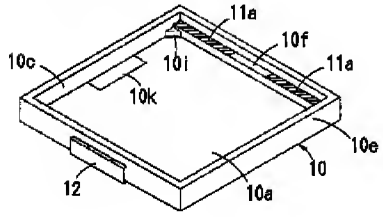


[Drawing 12]



[Translation done.]

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Ｈ０４Ｒ　17/00		Ｈ０４Ｒ　17/00	５Ｄ００４

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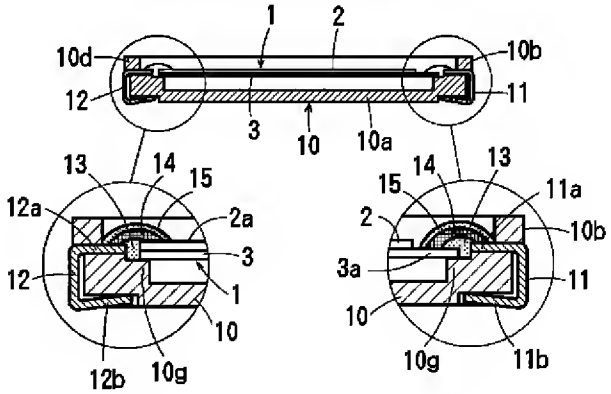
(71)出願人　000006231
株式会社村田製作所
京都府長岡京市天神二丁目26番10号
(72)発明者　竹島　哲夫
京都府長岡京市天神二丁目26番10号　株式会社村田製作所内
(72)発明者　炭田　学
京都府長岡京市天神二丁目26番10号　株式会社村田製作所内
(74)代理人　100085497
弁理士　筒井　秀隆

最終頁に続く

(54)【発明の名称】　圧電型電気音響変換器およびその製造方法

(57)【要約】　（修正有）
【課題】薄肉な振動板をケースに固定する接着剤および電気的接続を行う導電性接着剤の塗布位置を工夫することで、振動板の歪みを防止し、周波数特性の安定した圧電型電気音響変換器を提供する。
【解決手段】電極間に交番信号を印加することにより板厚方向に屈曲振動する四角形の圧電振動板１の外周部と端子の内部接続部１１ａ，１２ａとの間であって、圧電振動板１と内部接続部とを結ぶ最短経路に塗布され、圧電振動板をケースに対して固定する第１の接着剤１３と、圧電振動板の電極と端子の内部接続部との間に、第１の接着剤１３の上面を介して、かつ圧電振動板と内部接続部とを結ぶ最短経路を迂回して塗布され、圧電振動板の電極と端子の内部接続部との間を電気的に接続する導電性接着剤１４と、圧電振動板の外周部とケースの内周部との隙間を封止する第２の接着剤１５とを備える。



【特許請求の範囲】
【請求項１】電極間に交番信号を印加することにより板厚方向に屈曲振動する四角形の圧電振動板と、側壁部の内側に圧電振動板を支持する支持部を持つ四角形の絶縁性ケースと、上記支持部近傍に内部接続部が露出し、この内部接続部と導通する外部接続部がケースの外面に露出した端子電極と、圧電振動板の外周部と内部接続部との間であって、圧電振動板と内部接続部とを結ぶ最短経路に塗布され、圧電振動板をケースに対して固定する第１の接着剤と、圧電振動板の電極と端子電極の内部接続部との間に、第１の接着剤の上面を介して、かつ圧電振動板と内部接続部とを結ぶ最短経路を迂回して塗布され、圧電振動板の電極と端子電極の内部接続部とを電気的に接続する導電性接着剤と、圧電振動板の外周部とケースの内周部との隙間を封止する第２の接着剤とを備え、上記第１および第２の接着剤は導電性接着剤より硬化状態でのヤング率が小さいことを特徴とする圧電型電気音響変換器。
【請求項２】上記第１の接着剤は第２の接着剤に比べて、未硬化状態での粘性が高く、滲みにくい性質を有することを特徴とする請求項１に記載の圧電型電気音響変換器。
【請求項３】上記第１の接着剤は、圧電振動板の４つの角部近傍に部分的に塗布されていることを特徴とする請求項１または２に記載の圧電型電気音響変換器。
【請求項４】上記導電性接着剤は、圧電振動板の４つの角部近傍のうち、少なくとも２箇所に塗布されていることを特徴とする請求項３に記載の圧電型電気音響変換器。
【請求項５】電極間に交番信号を印加することにより板厚方向に屈曲振動する四角形の圧電振動板を準備する工程と、側壁部の内側に、圧電振動板を支持する支持部を持ち、上記支持部近傍に内部接続部が露出し、この内部接続部と導通する外部接続部が外部に露出した端子電極を持つ四角形の絶縁性ケースを準備する工程と、圧電振動板の外周部と内部接続部との間であって、圧電振動板と内部接続部とを結ぶ最短経路に第１の接着剤を塗布し硬化させて、圧電振動板をケースに対して固定する工程と、圧電振動板の電極と端子電極の内部接続部との間に、第１の接着剤の上面を介して、かつ圧電振動板と内部接続部とを結ぶ最短経路を迂回して導電性接着剤を塗布し硬化させて、圧電振動板の電極と端子電極の内部接続部とを電気的に接続する工程と、圧電振動板の外周部とケースの内周部との隙間に第２の接着剤を塗布し硬化させて、両者の間を封止する工程とを備え、上記第１および第２の接着剤は導電性接着剤より硬化状態でのヤング率が小さいことを特徴とする圧電型電気音響変換器の製造方法。
【請求項６】上記第１の接着剤は第２の接着剤に比べて、未硬化状態での粘性が高く、滲みにくい性質を有することを特徴とする請求項５に記載の圧電型電気音響変換器の製造方法。
【請求項７】上記第１の接着剤は、圧電振動板の４つの角部近傍に部分的に塗布されることを特徴とする請求項５または６に記載の圧電型電気音響変換器の製造方法。
【請求項８】上記導電性接着剤は、圧電振動板の４つの角部近傍のうち、少なくとも２箇所に塗布されることを特徴とする請求項７に記載の圧電型電気音響変換器。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は圧電ブザーや圧電受話器などの圧電型電気音響変換器およびその製造方法に関するものである。
【０００２】
【従来の技術】従来、電子機器、家電製品、携帯電話機などにおいて、警報音や動作音を発生する圧電ブザーあるいは圧電受話器として圧電型電気音響変換器が広く用いられている。この種の圧電型電気音響変換器は、円形の金属板の片面に円形の圧電素子を貼り付けてユニモルフ型振動板を構成し、金属板の周縁部を円形のケースの中にシリコーンゴムを用いて支持するとともに、ケースの開口部をカバーで閉鎖した構造のものが一般的である。しかしながら、円形の振動板を用いると、生産効率が悪く、音響変換効率が低く、しかも小型に構成することが難しいという問題点があった。
【０００３】そこで、四角形の振動板を用いることで、生産効率の向上、音響変換効率の向上および小型化を可能とした圧電型電気音響変換器が提案されている（特開２０００－３１０９９０号）。この圧電型電気音響変換器は、四角形の圧電振動板と、底壁部と４つの側壁部とを有し、対向する２つの側壁部の内側に振動板を支持する支持部を持ち、支持部に外部接続用の第１と第２の導電部が設けられた絶縁性ケースと、放音孔を有する蓋板とを備え、ケース内に振動板が収納され、振動板の対向する２辺と支持部とが接着剤または弾性封止材で固定されるとともに、振動板の残りの２辺とケースとの隙間が弾性封止材で封止され、振動板と第１，第２の導電部とが導電性接着剤により電気的に接続され、ケースの側壁部開口端に蓋板が接着された構造となっている。
【０００４】
【発明が解決しようとする課題】近年、圧電型電気音響変換器に使用される振動板は非常に薄くなり、数十～百μｍ程度の薄肉な振動板が使用されている。このような薄肉な振動板を用いた場合には、その支持構造が周波数特性に与える影響が大きくなる。例えば振動板と外部電極との間を、ウレタン系などの熱硬化型の導電性接着剤で直接接続すると、導電性接着剤の硬化収縮応力により振動板に歪みが発生し、周波数特性がばらつく。また、周囲の温度が変化すると、ケースと振動板との熱膨張係数差により特性が変化したり、ケースに外力が加わった

時に振動板にも直接力が伝達され、特性が変化することがある。

【０００５】上記のように弾性支持材で振動板とケースとを固定した後、その上に導電性接着剤を塗布しても、導電性接着剤が振動板の対向する２辺とケースの支持部、つまり、外部電極に導通する内部接続部との間を結ぶ最短経路に塗布されていると、導電性接着剤の硬化収縮によって発生する応力が振動板に作用し、周波数特性がばらつくなどの問題が発生することがある。

【０００６】そこで、本発明の目的は、振動板をケースに固定する接着剤および電気的接続を行う導電性接着剤の塗布位置を工夫することで、振動板の歪みを防止し、周波数特性の安定した圧電型電気音響変換器およびその製造方法を提供することにある。

【０００７】

【課題を解決するための手段】上記目的を達成するため、請求項１に係る発明は、電極間に交番信号を印加することにより板厚方向に屈曲振動する四角形の圧電振動板と、側壁部の内側に圧電振動板を支持する支持部を持つ四角形の絶縁性ケースと、上記支持部近傍に内部接続部が露出し、この内部接続部と導通する外部接続部がケースの外面に露出した端子電極と、圧電振動板の外周部と内部接続部との間であって、圧電振動板と内部接続部とを結ぶ最短経路に塗布され、圧電振動板をケースに対して固定する第１の接着剤と、圧電振動板の電極と端子電極の内部接続部との間に、第１の接着剤の上面を介して、かつ圧電振動板と内部接続部とを結ぶ最短経路を迂回して塗布され、圧電振動板の電極と端子電極の内部接続部とを電気的に接続する導電性接着剤と、圧電振動板の外周部とケースの内周部との隙間を封止する第２の接着剤とを備え、上記第１および第２の接着剤は導電性接着剤より硬化状態でのヤング率が小さいことを特徴とする圧電型電気音響変換器を提供する。

【０００８】請求項５に係る発明は、電極間に交番信号を印加することにより板厚方向に屈曲振動する四角形の圧電振動板を準備する工程と、側壁部の内側に、圧電振動板を支持する支持部を持ち、上記支持部近傍に内部接続部が露出し、この内部接続部と導通する外部接続部が外部に露出した端子電極を持つ四角形の絶縁性ケースを準備する工程と、圧電振動板の外周部と内部接続部との間であって、圧電振動板と内部接続部とを結ぶ最短経路に第１の接着剤を塗布し硬化させて、圧電振動板をケースに対して固定する工程と、圧電振動板の電極と端子電極の内部接続部との間に、第１の接着剤の上面を介して、かつ圧電振動板と内部接続部とを結ぶ最短経路を迂回して導電性接着剤を塗布し硬化させて、圧電振動板の電極と端子電極の内部接続部とを電気的に接続する工程と、圧電振動板の外周部とケースの内周部との隙間に第２の接着剤を塗布し硬化させて、両者の間を封止する工程とを備え、上記第１および第２の接着剤は導電性接着剤より硬化状態でのヤング率が小さいことを特徴とする圧電型電気音響変換器の製造方法を提供する。

【０００９】本発明では、振動板の外周部と端子電極の内部接続部との間を第１の接着剤で固定した後、導電性接着剤によって圧電振動板の電極と端子電極の内部接続部との間を電気的に接続する。このとき、第１の接着剤は圧電振動板の外周部と内部接続部との間であって、圧電振動板と内部接続部とを結ぶ最短経路に塗布，硬化され、導電性接着剤は第１の接着剤の上面を介して、かつ圧電振動板と内部接続部とを結ぶ最短経路を迂回して塗布，硬化される。第１の接着剤は導電性接着剤より硬化状態でのヤング率が小さいので、導電性接着剤の硬化収縮によって発生する応力は第１の接着剤によって緩和され、圧電振動板に直接作用しない。そのため、圧電振動板の歪みが発生せず、周波数特性がばらつくことがない。また、周囲の温度が変化した時やケースに外力が加わった時も、第１の接着剤が応力を緩和するので、圧電振動板には殆ど応力が波及せず、周波数特性が変化するのを防止できる。

【００１０】本発明の圧電型電気音響変換器を製造するに際し、圧電振動板をケースに収納した後、第１の接着剤を塗布してもよいし、圧電振動板をケースに収納する前に圧電振動板の外周部またはケースの支持部近傍に第１の接着剤を塗布してもよい。前者の場合には、ディスペンサを用いて第１の接着剤が塗布されるが、後者の場合は、ディスペンサを用いる方法に限らず、コテなどを用いて圧電振動板の端部に第１の接着剤を塗布し、この圧電振動板をケースに収納することにより、接着固定してもよい。

【００１１】請求項２のように、第１の接着剤は第２の接着剤に比べて、未硬化状態での粘性が高く、滲みにくい性質を有するものが望ましい。すなわち、第１の接着剤が未硬化状態での粘性が低く、滲みやすい場合には、第１の接着剤が圧電振動板の電極や端子電極の内部接続部を塞いでしまい、導電性接着剤を塗布するとき、圧電振動板の電極や端子電極の内部接続部と導通させることが困難になることがある。また、圧電振動板の外周部と内部接続部とを結ぶ最短経路部分に第１の接着剤がとどまらないこともある。そこで、滲みにくい性質の第１の接着剤を用いることで、このような問題を解消し、圧電振動板と端子電極とを導電性接着剤により確実に最短経路を迂回して接続することができる。

【００１２】請求項３のように、第１の接着剤を圧電振動板の４つの角部近傍に部分的に塗布するのがよい。第１の接着剤として、加熱硬化型の接着剤を使用した場合、ケースの４辺の中央部ほど変形が大きくなり、圧電振動板への応力も、４辺の中央部に応力が大きく作用する。これに対し、第１の接着剤を圧電振動板の４つの角部近傍に部分的に塗布すれば、第１の接着剤の硬化時にケースの変形が小さいため、圧電振動板への影響が少な

くて済む。

【００１３】請求項４のように、導電性接着剤は、圧電振動板の４つの角部近傍のうち、少なくとも２箇所に塗布してもよい。請求項３のように第１の接着剤を圧電振動板の４つの角部近傍に部分的に塗布すれば、圧電振動板の歪みの発生を抑制できるが、さらに請求項４のように導電性接着剤を第１の接着剤のうちの少なくとも２箇所に塗布することで、導電性接着剤の硬化収縮により発生する応力による歪みの影響を一層少なくできる。

【００１４】振動板はその支持方法により、長さベンディングモードで屈曲振動する場合と、面積屈曲モードで屈曲振動する場合とがある。前者は、長さ方向両端部を支点として板厚方向に屈曲振動するモードである。後者は４辺または４点を支点として振動板の主面をなす２つの対角線位置が最大変位となるように、つまり対角線の交点が最大変位量となるように振動板の面積全体が厚み方向に屈曲振動するモードである。

【００１５】本発明において、導電性接着剤としてはウレタン系の導電ペーストが望ましい。第１の接着剤としては、硬化状態におけるヤング率が導電性接着剤剤より低いものが使用され、例えばウレタン系接着剤を使用できる。第２の接着剤としては、第１の接着剤よりさらにヤング率が低く、硬化収縮応力も低いものがよく、例えばシリコーン系接着剤を使用することができる。なお、第１，第２の接着剤として常温硬化型の接着剤を使用することも可能であるが、ディスペンサなどで塗布する際、塗布の途中で硬化を開始するので、ディスペンサに詰まりが発生しやすく、作業性が悪い。これに対し、熱硬化型の接着剤であれば、常温では粘度が一定しているので、塗布の途中で粘度が変化せず、ディスペンサに詰まりが発生せず、作業性が良いという利点がある。

【００１６】

【発明の実施の形態】図１～図５は本発明の第１の実施形態である表面実装型の圧電型電気音響変換器を示す。この電気音響変換器は、サウンダやリンガなどのように単一周波数で用いられる用途に適したものであり、大略、ユニモルフ型の振動板１とケース１０と蓋板２０とで構成されている。

【００１７】振動板１は、図５に示すように、表裏面に薄膜または厚膜の電極２ａ，２ｂを有し、厚み方向に分極された４角形の圧電板２と、圧電板２と幅寸法が同一で長さ寸法がやや長い四角形に形成され、圧電板２の裏面電極２ｂに導電性接着剤などを介して対面接着された金属板３とで構成されている。なお、裏面電極２ｂを省略し、金属板３を圧電板２の裏面に導電性接着剤などを介して直接接合することで、裏面電極２ｂを省略してもよい。この実施例では、圧電板２が金属板３に対して長さ方向の一辺側へ偏った位置に接着されており、金属板３の長さ方向の他辺側には金属板３が露出した露出部３ａを有する。

【００１８】圧電板２としては、例えばＰＺＴなどの圧電セラミックスが用いられる。また、金属板３は良導電性とバネ弾性とを兼ね備えた材料が望ましく、例えばリン青銅，４２Ｎｉなどのヤング率が圧電板２と近い材料が望ましい。ここでは、金属板３として、セラミック（ＰＺＴ等）と熱膨張係数が近く、縦×横×厚みが１０ｍｍ×１０ｍｍ×０．０５ｍｍの４２Ｎｉ製金属板を使用した。また、圧電板２として縦×横×厚みが８ｍｍ×１０ｍｍ×０．０５ｍｍのＰＺＴ板を用いた。

【００１９】ケース１０はセラミックスまたは樹脂などの絶縁性材料で底壁部１０ａと４つの側壁部１０ｂ～１０ｅとを持つ４角形の箱型に形成されている。ケース１０を樹脂で構成する場合には、ＬＣＰ（液晶ポリマー），ＳＰＳ（シンジオタクチックポリスチレン），ＰＰＳ（ポリフェニレンサルファイド），エポキシなどの耐熱樹脂が望ましい。４つの側壁部１０ｂ～１０ｅの内周には環状の段差部１０ｆが設けられ、対向する２つの側壁部１０ｂ，１０ｄの内側の段差部１０ｆ上に、端子電極である一対の端子１１，１２の内部接続部１１ａ，１２ａが露出している。端子１１，１２はケース１０にインサート成形されたものであり、ケース１０の外部に突出した外部接続部１１ｂ，１２ｂが側壁部１０ｂ，１０ｄの外面に沿ってケース１０の底面側へ折り曲げられている。この実施例では、端子１１，１２の内部接続部１１ａ，１２ａが二股状に別れており、これら二股状の内部接続部１１ａ，１２ａが段差部１０ｆの両端部近傍に位置し、しかも内部接続部１１ａ，１２ａは末広がりな逆三角形状をなしている。

【００２０】段差部１０ｆの内側には、図３に示すように、振動板１の周辺部を支持するための環状の支持部１０ｇが、段差部１０ｆより一段低く形成されている。そのため、支持部１０ｇ上に振動板１を載置すると、振動板１の天面と端子１１，１２の内部接続部１１ａ，１２ａの上面とがほぼ同一高さになる。なお、底壁部１０ａには第１の放音孔１０ｋが形成され、側壁１０ｅの上縁部には第２の放音孔となる切欠部１０１が形成されている（図１，図４参照）。

【００２１】上記振動板１は金属板３がケース１０の底壁部１０ａを向くようにケース１０内に収納され、４辺がケース１０の支持部１０ｇ上に載置される。そして、振動板１の４つの角部近傍が弾性支持材（第１の接着剤）１３によって接着固定される。すなわち、金属板３の露出部３ａの両端部近傍と端子１１の内部接続部１１ａとの間、つまり露出部３ａと内部接続部１１ａとを結ぶ最短経路が弾性支持材１３によって接着固定され、これと対向する辺の両端部近傍と端子１２の内部接続部１２ａとの間が弾性支持材１３によって接着固定される。この実施例では、振動板１の一方の対角の角部に塗布される弾性支持材１３は振動板１の側辺に沿って横長な楕円形あるいは長円形であり、他方の対角の角部に塗布さ

れる弾性支持材１３は円形の点滴状であるが、これに限るものではない。弾性支持材１３としては、例えば硬化後のヤング率が３．７×10^6 Ｐａのウレタン系接着剤が使用される。また、この弾性支持材１３の未硬化状態での粘性が後述する弾性封止材１５より高く（例えば５０～１２０ｄＰａ・ｓ）、滲みにくい性質を有するので、弾性支持材１３を塗布したとき、弾性支持材１３が山形に盛り上がる。弾性支持材１３を塗布した後、加熱硬化させる。なお、振動板１の固定方法としては、振動板１をケース１０に収納した後でディスペンサなどで弾性支持材１３を塗布してもよいが、振動板１に予め弾性支持材１３を塗布した状態で振動板１をケース１０に収容してもよい。

【００２２】弾性支持材１３によってケース１０に固定された振動板１と、端子１１，１２の内部接続部１１ａ，１２ａとを導電性接着剤１４によって電気的に接続する。すなわち、導電性接着剤１４を振動板１の一方の対角の角部に楕円形あるいは長円形に塗布された弾性支持材１３の上を交差するように楕円形に塗布する。弾性支持材１３は山形に盛り上がっているので、導電性接着剤１４は振動板１と内部接続部１１ａ，１２ａとを結ぶ最短経路を迂回して塗布される。この際、導電性接着剤１４が振動板１と内部接続部１１ａ，１２ａとの隙間であって弾性支持材１３が塗布されていない部位に付着しないように注意する必要がある。導電性接着剤１４としては、例えば硬化後のヤング率が０．３×10^9 Ｐａのウレタン系導電ペーストが使用される。導電性接着剤１４を塗布した後、これを加熱硬化させる。

【００２３】振動板１の周囲全周とケース１０の内周部との間は弾性封止材（第２の接着剤）１５で封止され、振動板１の表側と裏側との間の空気漏れが防止される。弾性封止材１５を環状に塗布した後、加熱硬化させる。この実施例では、弾性封止材１５として、例えば硬化後のヤング率が３．０×10^5 Ｐａのシリコーン系接着剤を使用している。

【００２４】上記のように振動板１をケース１０に固定した後、ケース１０の上面開口部に蓋板２０が接着剤２１によって接着される。蓋板２０はケース１０と同様な材料で形成される。蓋板２０を接着することで、蓋板２０と振動板１との間に音響空間が形成される。上記のようにして表面実装型の圧電型電気音響変換器が完成する。

【００２５】上記ケース１０に設けられた端子１１，１２間に所定の交番信号（交流信号または矩形波信号）を印加すれば、振動板１の４辺がケース１０の支持部１０ｇに固定されているので、振動板１は面積屈曲モードで振動し、所定の音を発生することができる。発生した音は、蓋板２０とケース１０の切欠部１０１との間で形成される放音穴から外部へ放出される。

【００２６】上記の説明では、振動板１の金属板３をケース１０の底壁部１０ａ側に向けて固定したが、圧電板２をケース１０の底壁部１０ａ側に向けて固定してもよい。金属板３を底壁部１０ａ側に向けて固定した場合には、圧電板２の表面電極２ａと金属板３の露出部３ａとが上側に露出するので、露出部３ａと端子１１との接続、および表面電極２ａと端子１２との接続を導電性接着剤１４を用いて簡単に行なうことができる。なお、表面電極２ａと端子１２とを接続する場合に、導電性接着剤１４が金属板３に付着すると接続不良になるが、上記のように弾性支持材１３が振動板１とケース１０との隙間に入り込み、導電性接着剤１４が金属板３に付着するのを阻止する役割を持つので、接続不良を確実に防止できる。

【００２７】図６～図１１は本発明の第２の実施形態である圧電型電気音響変換器を示す。この実施形態の電気音響変換器は、圧電受話器のように広いレンジの周波数に対応する用途に使用される。この電気音響変換器は、大略、積層構造の振動板３０とケース１０と蓋板２０とで構成されている。ケース１０と振動板３０とを除き、その他の構成は図１～図５に示された第１の実施形態とほぼ同一であり、同一部分には同一符号を付して重複説明を省略する。

【００２８】このケース１０が第１の実施形態におけるケース１０と異なる点は、図８に示すように支持部１０ｇが対向する２つの側壁１０ｂ，１０ｄの内側にのみ形成されている点、図９に示すように他の２つの側壁部１０ｃ，１０ｅの内側であって支持部１０ｇより低い位置に弾性封止材流れ止め用溝部１０ｈが形成されている点、蓋板２０に放音孔２３が形成されている点である。

【００２９】振動板３０は、図１０，図１１に示すように、２層の圧電セラミックス層３１，３２を積層したものであり、振動板３０の表裏主面には主面電極３３，３４が形成され、セラミックス層３１，３２の間には内部電極３５が形成されている。２つのセラミックス層３１，３２は、図１１に太線矢印で示すように厚み方向において同一方向に分極されている。表側の主面電極３３と裏側の主面電極３４は、振動板３０の辺長よりやや短く形成され、その一端は振動板３０の一方の端面に形成された端面電極３６に接続されている。そのため、表裏の主面電極３３，３４は相互に接続されている。内部電極３５は主面電極３３，３４とほぼ対称形状に形成され、内部電極３５の一端は上記端面電極３６と離れており、他端は振動板３０の他端面に形成された端面電極３７に接続されている。なお、振動板３０の他端部の表裏面には、端面電極３７と導通する補助電極３８が形成されている。

【００３０】振動板３０の表裏面には、主面電極３３，３４を覆う樹脂層３９が形成されている。この樹脂層３９は、振動板３０がセラミック材料のみで構成されているため、落下強度を高めるために設けられている。そし

て、表裏の樹脂層３９には、振動板３０の対角の角部近傍に、主面電極３３，３４が露出する切欠部３９ａと、補助電極３８が露出する切欠部３９ｂとが形成されている。なお、切欠部３９ａ，３９ｂは表裏一方にのみ設けてもよいが、表裏の方向性をなくすため、この例では表裏面に設けてある。また、補助電極３８は、一定幅の帯状電極とする必要はなく、切欠部３９ｂに対応する箇所のみ設けてもよい。ここでは、セラミックス層３１，３２として１０ｍｍ×１０ｍｍ×２０μｍのＰＺＴ系セラミックスを使用し、樹脂層３９として厚みが５～１０μｍのポリアミドイミド系樹脂を使用した。

【００３１】上記振動板３０がケース１０に収納され、４箇所で弾性支持材１３によってケース１０の支持部１０ｇに固定される。対角位置にある切欠部３９ａに露出する主面電極３３と端子１１の内部接続部１１ａとの間、および切欠部３９ｂに露出する補助電極３８と端子１２の内部接続部１２ａとの間に、弾性支持材１３が横長な楕円形に塗布される。また、残りの２箇所についても、弾性支持材１３が横長な楕円形に塗布される。塗布後、弾性支持材１３は加熱硬化される。なお、振動板３０の固定方法として、振動板３０をケース１０に収納した後でディスペンサなどで弾性支持材１３を塗布してもよいが、振動板３０に予め弾性支持材１３を塗布した状態で振動板３０をケース１０に収容してもよい。

【００３２】弾性支持材１３を硬化させた後、導電性接着剤１４を楕円形に塗布された弾性支持材１３の上を交差するように楕円形に塗布し、主面電極３３と端子１１の内部接続部１１ａ、補助電極３８と端子１２の内部接続部１２ａとをそれぞれ接続する。つまり、導電性接着剤１４は振動板３０と内部接続部１１ａ，１２ａとを結ぶ最短経路を迂回して塗布される。導電性接着剤１４を塗布した後、加熱硬化させる。

【００３３】導電性接着剤１４を塗布，硬化させた後、弾性封止材１５が振動板３０とケース１０の内周部との隙間に塗布され、両者の間が封止される。このとき、図９に示すように、２つの側壁部１０ｃ，１０ｅの内側に形成された溝部１０ｈで弾性封止材１５が受け止められるので、弾性封止材１５が底壁部１０ａまで流れ落ちることがない。そのため、振動板３０とケース１０との間が確実に封止される。

【００３４】この実施形態の電気音響変換器では、端子１１，１２間に所定の交番電圧を印加することで、振動板３０を屈曲振動させることができる。分極方向と電界方向とが同一方向である圧電セラミックス層は平面方向に縮み、分極方向と電界方向とが逆方向である圧電セラミックス層は平面方向に伸びるので、全体として厚み方向に屈曲する。この実施形態の場合には、振動板３０が金属板を有しないセラミックスの積層構造体であり、厚み方向に順に配置された２つの振動領域が相互に逆方向に振動するので、ユニモルフ型振動板に比べて大きな変位量、つまり大きな音圧を得ることができる。

【００３５】第２の実施形態では、ケースの２辺全長に支持部を設けたが、図１２に示すケース１０のように、４隅部に支持部１０ｉを設けてもよい。この場合には、振動板３０の４つの角部が支持部１０ｉに弾性支持材１３によって固定される。このように振動板３０の角部のみを支持することにより、共振周波数を下げることができ、低周波域の音圧を上げることができる。なお、図６，図１２では、側壁部１０ｃ，１０ｅの内側に設けられるわずかな巾の段差部１０ｆおよび溝部１０ｈ（図９参照）を省略した。

【００３６】本発明は上記実施形態に限定されるものではなく、本発明の趣旨を逸脱しない範囲で変更可能である。例えば、振動板３０は２層の圧電セラミックス層を積層したものであるが、３層以上の圧電セラミックス層を積層したものでもよい。また、振動板１，３０は正方形，長方形のいずれであってもよい。第１の実施形態では、金属板の片面に圧電板を貼り付けたユニモルフ型振動板について説明したが、金属板の両面に圧電板を貼り付けたバイモルフ形振動板を使用してもよい。上記実施形態では、ケースの支持部を端子電極の内部接続部より一段低くし、ケースの支持部に支持された振動板と内部接続部とがほぼ同一高さになるように設定したが、ケースの支持部と内部接続部とを同一高さとし、その上に振動板を固定してもよい。本発明における端子電極とは、上記実施形態のようなインサート端子に限るものではなく、例えばケースの支持部上面から外部に至る薄膜あるいは厚膜の電極であってもよい。上記実施形態では、第１の接着剤（弾性支持材）として第２の接着剤より滲みにくい材料を使用したが、同一材料を用いてもよい。第１の接着剤の塗布位置は、振動板の４つの角部付近に部分的に塗布したものに限らず、振動板の対向する２辺の全長に亘って連続的に塗布してもよい。また、導電性接着剤の塗布位置は、振動板の対角の２箇所に限らず、振動板の電極を外部に引き出すためであれば、如何なる位置でもよい。本発明のケースは、実施形態のような凹断面形状のケースと、その上面に接着される蓋板とで構成されたものに限らない。

【００３７】

【発明の効果】以上の説明で明らかなように、請求項１に記載の発明によれば、振動板の外周部とケースの支持部近傍との間を第１の接着剤で固定した後、導電性接着剤によって圧電振動板の電極と端子電極の内部接続部との間を電気的に接続する際、導電性接着剤は第１の接着剤の上面を介して、かつ圧電振動板と内部接続部とを結ぶ最短経路を迂回して塗布，硬化されるので、導電性接着剤の硬化収縮応力は第１の接着剤によって緩和され、圧電振動板に直接作用しない。そのため、薄肉な圧電振動板であっても歪みが発生せず、周波数特性がばらつくことがない。また、周囲の温度が変化した時やケースに

外力が加わった時も、第１の接着剤が応力を緩和するので、圧電振動板には殆ど応力が波及せず、周波数特性が変化するのを防止できるという作用効果を有する。

【図面の簡単な説明】

【図１】本発明に係る圧電型電気音響変換器の第１実施形態の分解斜視図である。

【図２】図１に示す圧電型電気音響変換器の蓋板および第２の接着剤を除外した状態の平面図である。

【図３】図２のＡ－Ａ線による階段断面図である。

【図４】図２のＢ－Ｂ線断面図である。

【図５】図１の圧電型電気音響変換器に用いられる圧電振動板の斜視図である。

【図６】本発明に係る圧電型電気音響変換器の第２実施形態の分解斜視図である。

【図７】図６に示す圧電型電気音響変換器の蓋板および第２の接着剤を除外した状態の平面図である。

【図８】図７のＣ－Ｃ線による階段断面図である。

【図９】図７のＤ－Ｄ線断面図である。

【図１０】図６の圧電型電気音響変換器に用いられる圧電振動板の斜視図である。

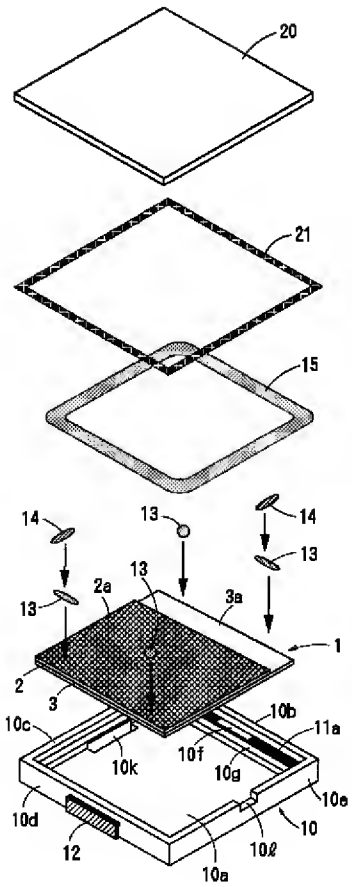
【図１１】図１０のＥ－Ｅ線による階段断面図である。

【図１２】ケースの変形例の斜視図である。

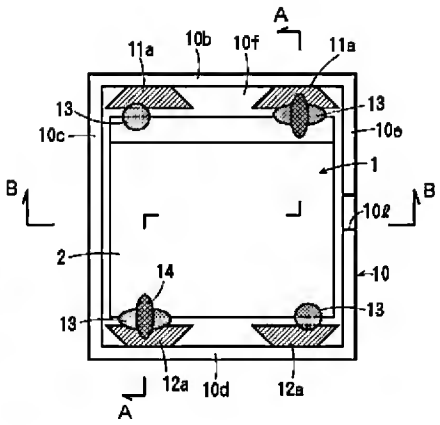
【符号の説明】

１，３０	圧電振動板
１０	ケース
１０ｇ	支持部
１１，１２	端子（端子電極）
１１ａ，１２ａ	内部接続部
１１ｂ，１２ｂ	外部接続部
１３	弾性支持材（第１の接着剤）
１４	導電性接着剤
１５	弾性封止材（第２の接着剤）
２０	蓋板

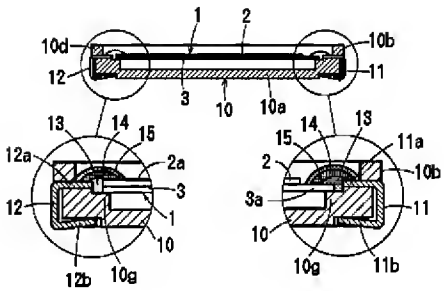
【図１】



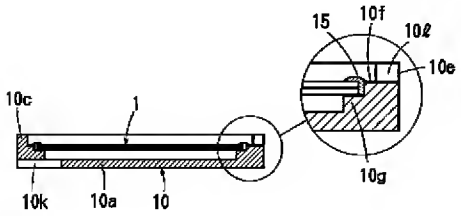
【図２】



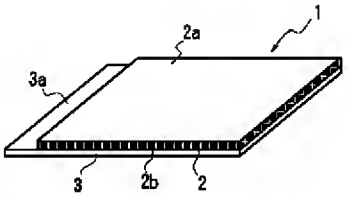
【図３】



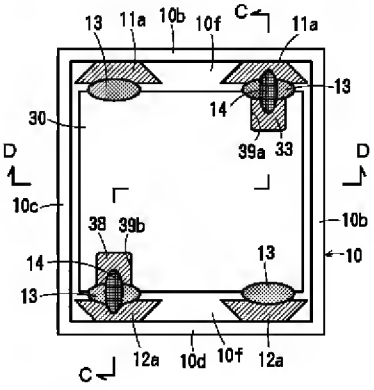
【図４】



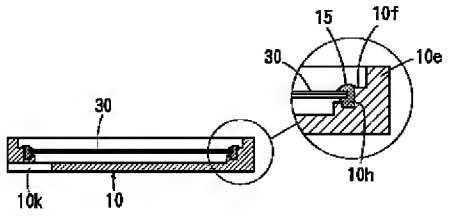
【図５】



【図７】

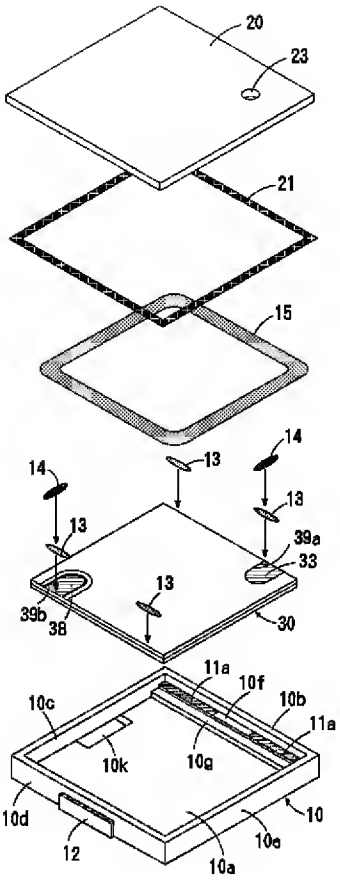


【図８】

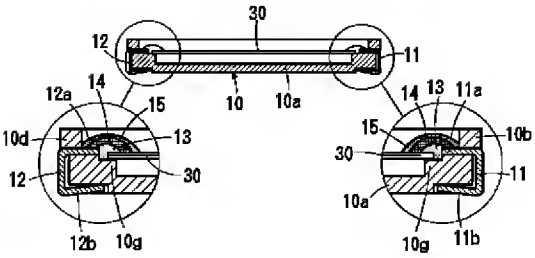


【図９】

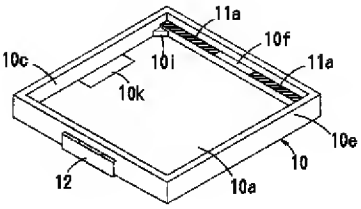
【図６】



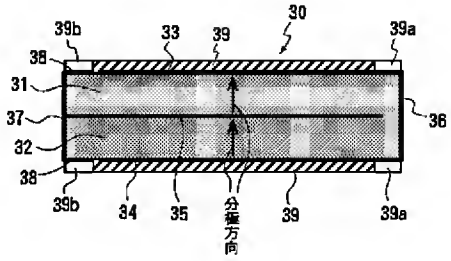
【図８】



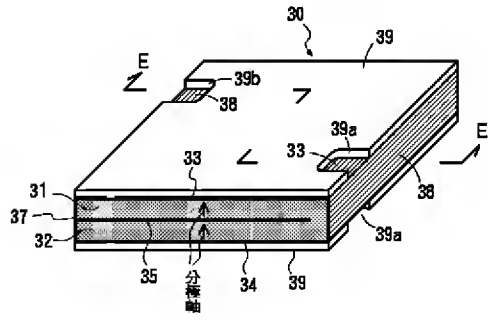
【図１２】



【図１１】



【図１０】



フロントページの続き

(72)発明者　田島　清高
京都府長岡京市天神二丁目26番10号　株式会社村田製作所内

(72)発明者　坂井　雄一
京都府長岡京市天神二丁目26番10号　株式会社村田製作所内

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